1   A.   My illustration explains why Verizon VA's investment risk is large under the UNE

2   regime and accompanying TELRIC standard. As shown by my illustration, the expected

3   present value of Verizon VA's revenues will be less than the present value of its TELRIC

4   expenses plus investment. Whenever the present value of revenues is **less** than the

5   present value of expenses plus investment, a company's return on investment will be less

6   than its cost of capital. Thus, Verizon VA's expected rate of return on investment is less

7   than its cost of capital.

8   **Q.   Don't unregulated companies in competitive markets also face the risk that their**

9   **   returns on investment will be less than their cost of capital?**

10 A.   Yes. Competitive companies always face some risk that their returns on investment will

11   be less than their costs of capital. However, unregulated competitive companies also

12   have a significant probability that they will earn a return on investment that *exceeds* their

13   cost of capital. Moreover, unlike Verizon VA, unregulated competitive companies are

14   free to set prices that reflect realistic assumptions regarding investment, expenses, and

15   depreciation, and realistic estimates of the risks and costs of technological change. In

16   addition, competitive companies can use realistic demand forecasts and, if those forecasts

17   are exceeded, their revenues will be higher than expected. And unregulated competitive

18   companies do not have an obligation to provide facilities to competitors under cancelable

19   leases that by design arc intended to facilitate the transition by those competitors to

20   alternative facilities or technologies. Unregulated competitive companies will not

21   undertake investments when the expected rate of return on investment is less than their

22   cost of capital.

1 **Q. What does your illustration say about the value of the CLECs' option to cancel their**

2 **lease or renew their lease at lower rates?**

3 A. My illustration explains why the CLECs' option to cancel or renew at lower rates is a

4 valuable asset that the CLECs will have acquired from Verizon VA at zero cost if the

5 value of the option is not built into the UNE rate. In short, when Verizon VA invests in

6 its fixed network, while CLECs have a cancelable operating lease on the network, CLECs

7 have valuable flexibility to reduce their expenses when new technologies become

8 available. Of course, Verizon VA can only offer the CLECs this flexibility by incurring a

9 fixed cost that restricts its own flexibility. Verizon VA will have no incentive to invest in

10 network facilities, and CLECs will receive improper price signals, if the value of the

11 CLECs' option is not included in the price of the UNE.

12 **B. Description of Risk Premium Methodology**

13 **Q. What methodology did you use to value the CLECs' ability to cancel or renew their**

14 **UNE lease at lower rates?**

15 A. I used the binomial option pricing methodology described in an article by Copeland and

16 Weston, "A Note on the Evaluation of Cancellable Operating Leases," published in the

17 Summer 1982 issue of *Financial Management* and provided as Attachment 1. This

18 methodology is widely employed by financial analysts to value the options that are traded

19 in financial markets and is more flexible than its predecessor, the Black-Scholes model.

20 It is based on the assumptions that (1) the value of the underlying asset can either

21 increase or decrease at discrete points in time, and (2) lessees can exercise the option to

22 renew the lease at lower rates or cancel altogether once they observe the new value **of** the

23 underlying asset. In the context of my analysis of regulatory risk, the binomial option

24 pricing methodology is conservative because it assumes that the value of the network can

1		either increase or decrease, whereas, under TELRIC, the value of the network is likely
2		only to decrease as new lower-cost technologies become available.
3	**Q.**	**Does your methodology apply regardless of whether the CLECs actually renew their**
4		**lease at lower rates or cancel their lease and use alternative facilities or**
5		**technologies?**
6	**A.**	Yes. My methodology can best be thought of as a way to estimate the value CLECs
7		receive from having the option to obtain UNEs at a lower lease rate whenever regulators
8		reduce rates or to cancel altogether at any time.
9	**Q.**	**Please describe in more detail your methodology for calculating the regulatory risk**
10		**premium associated with the UNE regime and the TELRIC standard.**
11	**A.**	I estimated this regulatory risk premium in several steps. First, I used the same fonvard-
12		looking investment, operating expenses, depreciation, and asset lives presented by
13		Verizon VA in this proceeding.
14		Second, I calculated the minimum lease payments that would allow Verizon VA
15		to recover the TELRIC cost of its network investment, pay its operating expenses and
16		taxes, and earn a fair rate of return on its network investment under the assumption that
17		CLECs cannot renew or cancel their lease of network facilities. In short, the lease
18		payments in this step were calculated as if the CLECs' lease contract with Verizon VA
19		were a financial lease rather than an operating lease.
20		Third, I calculated the market value of the CLECs' option to renew their lease at
21		lower rates using the binomial option pricing methodology noted above and described in
22		the Copeland and Weston article provided in Attachment 1.

1   Fourth, using the value of the CLECs' option as an input, I calculated the

2   minimum lease payment that would allow Verizon VA to recover the cost of its network

3   investment, pay its operating expenses and taxes, and earn a fair rate of return on its

4   network investment when regulators periodically lower UNE rates.

5   Finally, from this information, I calculated the regulatory risk premium required

6   to compensate Verizon VA for some of the additional risk they incur under the UNE

7   regime and the TELRIC standard.

8   **Q.   Please describe the data you obtained from Verizon VA.**

9   A.   The data I obtained from Verizon VA are shown in Attachment 2. The data, which is the

10   same that Verizon VA has presented as its TELRIC costs in this case, show that Verizon

11   VA would have to invest more than $7 billion to reconstruct its telecommunications

12   network in Virginia using the most efficient technology currently available, that its

13   annual operating expenses would be almost $1.3 billion, and that the average life of this

14   network would be approximately 14.1 years.

15 **Q.   How did you calculate the minimum lease payments that would allow Verizon VA to**

16   **recover the TELRIC cost of its network investment, pay its operating expenses and**

17   **taxes, and earn a fair rate of return on its network investment, under the**

18   **assumption that the CLECs sign a non-cancelable financial lease for the use of**

19   **Verizon VA's network facilities?**

20 **A.**   I calculated the lease payments by equating the present value of the cash inflows under

21   the lease to the present value of Verizon VA's cash outflows for investments, operating

22   expenses, and taxes. Specifically, the calculation of the lease payments was made using

23   the equation:

1
$$ I = \sum_{t=1}^{T} \frac{(1 - \tau_c)(L_t - O_t) + \tau_c D_t}{(1 + ATWACC)^t} + \frac{MV}{(1 + ATWACC)^T} \quad \textbf{(1)} $$

2   where:

3   I   = investment in the network on total network basis

4   τ_c = composite corporate tax rate

5   L_t = monthly lease payment

6   D_t = monthly depreciation amount

7   O_t = monthly operating expense

8   T   = number of months in life of asset

9   MV   = salvage value of asset and

10   ATWACC = after-tax weighted average cost of capital

11

12   Using the data shown in Attachment 2 and my estimate of Verizon VA's after-tax

13   weighted average cost of capital,'' Equation (I) can be solved for the unknown monthly

14   lease payments.

15   **Q.** **Why did you use Verizon VA's after-tax weighted average cost of capital to discount**

16   **lease cash flows in your analysis?**

17   A. I used Verizon VA's after-tax weighted average cost of capital to discount lease cash

18   flows because it best reflects the financing mix and cost rates that Verizon **VA** would

19   need to use to finance its investment in the facilities required to provide UNEs. Since

20   CLECs use the leasing of UNEs as a substitute for building and owning their own

21   telecommunications facilities (or of using other alternative facilities or technologies), the

22   after-tax weighted average cost of capital provides correct economic signals for the lease

23   versus build decision.

---

[7]   The after-tax weighted average cost of capital reflects the tax deductibility of interest. Thus, for example, if the interest rate is 7% and the tax rate is 50%, the after-tax weighted average cost of capital will reflect 3.5% interest.

1   Q.   Some economists suggest that a financial lease is a substitute for debt financing

2   rather than for a mix of debt and equity financing as you have assumed. In this

3   application, why **is** it appropriate to assume a mix of debt and equity financing

4   rather than pure debt financing?

5   A.   In this application it is appropriate to assume a mix of debt and equity financing because

6   a company investing more than $7 billion to reconstruct Verizon VA's network in

7   Virginia could never finance this investment entirely with debt. Even if CLECs sign a

8   financial lease that requires them to purchase UNEs at a fixed rate for the entire life of

9   the network, there is no guarantee that CLECs could fulfill their contract. Indeed,

10   Verizon VA would still face the considerable risk that CLECs would default on their

11   lease payments due to bankruptcy. Verizon VA could only reduce its investment risk

12   through a mix of debt and equity financing. A financial lease is really a substitute for

13   owning an asset and is only a substitute for debt financing if the lessee could realistically

14   finance the asset with debt if they did not lease the asset. In the case of a

15   telecommunications network investment, it is simply unrealistic to assume that either the

16   CLEC or Verizon VA could finance ownership of the network entirely with debt.

17 Q.   How did you calculate the minimum lease payment that Verizon VA would have to

18   charge if the CLECs can renew their **UNE** lease when a regulatory body sets lower

19   rates?

20 A.   I calculated this minimum lease payment by equating the present value of the lease cash

21   inflows to the sum of the present value of Verizon VA's cash outflows for network

22   investment, operating expenses, and taxes; and the value of the option to renew the lease

1   at lower rates when rates are reset. Specifically, the calculation of the lease payment in

2   this scenario was made using the equation:

$$I = \sum_{t=1}^{T} \frac{(1 - \tau_c)(L_t - O_t) + \tau_c D_t}{(1 + ATWACC)^t} + \frac{MV}{(1 + ATWACC)^T} - P_A \quad \textbf{(2)}$$

4   where P_A is the value of the option to cancel, calculated according to Copeland/Weston,

5   and the remaining variables are defined as in Equation (1).

6   **Q.**   **How did you calculate the regulatory risk premium required to compensate Verizon**

7   **VA for the additional risk they incur because CLECs can cancel their leases and**

8   **regulators can lower UNE rates at any time?**

9   A.   I calculated this regulatory risk premium by substituting the value of the lease payments

10   (obtained from the previous step) into Equation (1) and solving for the after-tax weighted

11   average cost of capital. The required regulatory risk premium is the difference between

12   the required rate of return on the cancelable operating lease and the required rate of **return**

13   on the financial lease. Using the Verizon VA data, the regulatory risk premium is **5.41%.**

14   **Q.**   **Does this risk premium fully reflect the risks associated with the UNE regime and**

15   **the accompanying TELRIC pricing standard?**

16   A.   No. My risk premium only reflects the additional regulatory risk associated with the

17   regulators' option to lower UNE rates at any time to reflect the lower cost of a

18   hypothetical network using the then-most efficient available technology and the CLEC

19   option to cancel. It does not reflect all of the risks associated with the TELRIC pricing

20   standard, such as the optimistic expense and investment assumptions that are frequently

21   used in implementing the TELRIC standard. In addition, my regulatory risk premium

22   does not reflect the risk that under the TELRIC standard Verizon VA will be unable to

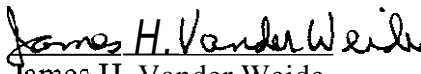23   recover the actual costs it incurs in building and operating its network.

1 **Q.** **Does this conclude your testimony?**

2 A.   Yes, it does.

Declaration of James H. Vander Weide

I declare under penalty of perjury that I have reviewed the foregoing testimony and that those sections as to which I testified are **true** and correct.

Executed on April 15, 2003

James H. Vander Weide

A Note on the Evaluation *of* Cancellable Operating Leases

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■ Many central theoretical issues on long-term leasing were settled by Miller and Upton [8], Lewellen, Long and McConnell [6], and Myers, Dill and Bautista [9].[1] Issues of clarification and implementation can be found in Levy and Sarnat [5]. The following paper extends the analysis of lease contracts to include cancellable operating leases.

For expositional purposes lease contracts can be divided into two broad categories: 1) pure financial leases and 2) operating leases. Pure financial leases are assumed to be perfect substitutes for debt capital because they are not cancellable without bankruptcy and they are fully amortized. On the other hand, operating leases are riskier from the lessor's point of view because they may be cancelled at the option of the lessee and cannot (by law) be fully amortized.

The first part of the paper provides a brief review of the analysis of pure financial leases. The second part solves the problem of evaluating cancellable operating leases by using the Cox, Ross and Rubinstein [2] binomial option pricing method. From the lessor's point of view a cancellable operating lease is equivalent to a pure financial lease minus an American put option with a (non-stochastic) declining exercise price. The expected rate of return on a cancellable lease is shown to be higher than the rate on a pure financial lease.

The Analysis of Pure Financial Leases

Pure financial leases are assumed to be perfect substitutes for debt. The lessee takes the before-tax rental rate, L_t, as an input in making a comparison between leasing and borrowing. The analysis involves the following differential cash flows:

a. A cash saving amounting to the dollar amount of the investment outlay, I, which the firm does not have to incur if it leases.

b. A cash outflow amounting to the present value of the after-tax lease dollars which must be paid out, $PV[(1 - \tau_c)L_t]$.

We wish to thank Dan Galai, Robert Geske and Kuldeep Shastri for their helpful comments.

[1] The distinction between long-term and short-term leases is not trivial. Short-term leases such as hotel room rentals are probably more efficient than buying for a day simply because of transaction cost differences. However, the effect of such frictions is minimized for long-lived contracts.

60

c. The present value of the opportunity cost of the lost depreciation tax shield, $PV(\tau_c dep_t)$.

d. The present value of the change in the interest tax shield on debt which is displaced by lease financing, $PV[\tau_c\Delta(rD_t)]$, where D_t is the remaining principal of displaced debt in period t, and r is the coupon rate. These four terms, when discounted at the proper rate, give the net present value (NPV) of the lease contract to the lessee. If the NPV (to lessee) > 0 the lease will be accepted.

$$NPV \ (lessee) = I - PV\{(I-\tau_c)L_t\} - PV[\tau_c dep_t] - PV[\tau_c\Delta(rD_t)] \quad (1)$$

Because this definition of cash flows explicitly includes the tax shield of displaced debt in the numerator of the present value equation. the cash flows should be discounted at the before-tax cost of capital. The before-tax cost of debt capital, k_b is relevant because the lease contract is a perfect substitute for debt. It has the same risk. Therefore. we have

$$NPV \ (lessee) = I - \sum_{t=1}^{N} \frac{(I-\tau_c)L_t + \tau_c dep_t + \tau_c\Delta(rD_t)}{(I + k_b)^t} \quad (2)$$

If correct. this approach should show the lessee to br indifferent to the contract (i.e., NPV (lessee) = 0) when the lessor's minimum lease fee is substituted into the equation. The computation is fairly cumbersome because the displaced tax shield. $\tau_c\Delta(rD_t)$, changes each period.

Myers, Dill and Bautista [9] and Levy and Sarnat [5] have shown that an equivalent approach is to account for the Interest tax shield by discounting at the after-tax cost of debt and eliminating the third term from the numerator of the' righthand side of Equation (2). For constant lease payments, Equations (2) and (3) are equivalent.

$$NPV \ (lessee) = I - \sum_{t=1}^{N} \frac{(I-\tau_c)L_t + \tau_c dep_t}{[I+(I-\tau_c)k_b]^t} \quad (3)$$

Note that from the lessor's point of view k_b is the lending rate on debt capital. It is the lessor's weighted average cost of capital. WACC (lessor), grossed up by the lessor's effective marginal tax rate.[2]

$$k_b = \frac{WACC(lessor)}{(I - \tau_c)} \quad (4)$$

Therefore, when discounting the cash flows of Equation (3) from the lessor's point of view, we have

$$NPV(to \ lessor) = - I$$
$$+ \sum_{t=1}^{N} \frac{L_t(I-\tau_c) + \tau_c dep_t}{(I + WACC)^t} \quad (5)$$

where $WACC(lessor) = (I-\tau_c)k_b$. The equivalence of Equations (3) and (5) decisions Intes that the financing decision is the same from either the lessee's or lessor's point of view. Also, it is worth mentioning that the lessee's indifference to the contract will result only when all terms in Equations (3) and (5) are symmetrical. Especially important are the effective tax rates of the lessor and lessee. Lewellen, Long and McConnell [6] liuve shown that with different effective tax rates for the lessor and lessee the lease may have positive net present values for both parties.

The Evaluation of Operating Lease Contracts

Operating leases are different from pure financial leases in two important ways. First. and most important, they may be cancelled at the option of the lessee. From the point of view of the lessee, capital employed under operating lease contracts becomes a variable cost (rather than a fixed cost) because the lease may be terminated (sometimes requiring a penalty tu be paid) and the leased asset may he returned whenever economic conditions worsen. This is like having equipment that can be laid off. From the lessor's point of view. operating leases are obviously riskier than financial leases. A financial lease, like a loan, is secured by all of the firm's assets. An operating lease is not. The second difference lxlwc.cn operating and financial leases is that operating leases enable the lessor to capture the salvage value of the asset.

The duration of an operating lease is usually several years on business office equipment, computers. buildings, and trucks. The contracts are not renegotiated during their term. However. they can usually be cancelled ut the option of the customer (sometimes with and sometimes without penalty). For example, the wording. in an IBM contract is: ". . . the customer may, at any time after installation, discontinue a processor complex unit upon three months prior written notice, or discontinue any other machine or any field removable feature or request a field removable down-

grade upon one **month's** written notice'' [subject to the payment of terminition charges].

What are the **sources** of risk to a lessor who contemplates extending an operating lease? We shill discuss two categories of risk. The first category of risk affects fluctuutions in the economic value **of** the asset over time. These changes in value result from the uncertain economic rate of *depreciation* of the asset and, from general price, level and interest rate uncertainty. The economic rate of depreciation is determined by the value of the **asset** in alternative uses **and from the** competition of substitutes. Changes in value will reflect obsolescence as well as physical deterioration. This may be termed *replacement cost risk.* The uncertainty of the salvage value of the asset is a special **case** of this first category of risks related to the economic value of the asset. Our intent is to define replacement cost risk as the generic term lor fluctuations in the economic value of the asset resulting from uncertainties such as obsolescence costs and unanticipated changes in the general price level and interest rates.

A **second** category of risk relates to the characteristics of the lessee and we shall argue that 'they are of no special concern to *the* lessor. (The reason is discussed below.) Related to the performance of the lessee is a **revenue risk.** This is the risk that the lease will be cancelled because the lessee's revenues from the asset fall enough so that the present value of the lease payments exceeds the **present** value of continued use of the **asset.**

Another source of risk related *to* the behavior of the lessee is the *risk of default.* Default is an involuntary breach of the lease contract. It is common to both financial leases and operating leases. Therefon, we shall assume that the lessor's lending rate, k is already adjusted to compensate for default risk.

The usual approach to the operating lease problem is to separate each of the different components of risky **cash flow and** discount them at the ''appropriate'' risk-adjusted discount rate.[3] The type of formula **often used** is:

NPV(to lessee) =

$$
I - \sum_{t=1}^{N} \frac{L_t(1-\tau_c)}{(1+k_d^*)^t} - \sum_{t=1}^{N} \frac{\tau_c dep_t}{(1+k_d^*)^t}
$$
$$
-\tau_i I - \frac{MV}{(1+k_i)^N} + \frac{t_c(MV-BV)}{(1+k_i)^N} - \sum_{t=1}^{N} \frac{O_t}{(1+k_i)^t}
$$
$$
\tag{6}
$$

where
$k_d^* = (1 - \tau_c)k_d =$ the after-tax **cost** of. **debt** capital;

$\tau_i I =$ the investment tax credit forgone by the lessee;

$MV =$ the **salvage value (market value)** of the asset wlien the lease contract expires in year N;

$k_i =$ the risk-adjusted after-tax discount rate ''appropriate'' to salvage risk;

$t_g(MV-BV) =$ the capital gains tax **on the differ-** ence between the salvage value and the **book** value;

$O_t =$ the value of operating maintenance' in period t;

$k_i =$ the risk-adjusted after-tax discount rate ''appropriate'' to the maintenance costs.

While this **approach** is useful in pointing out the different risks that exist, the practitioner is forced to use ad hoc 'rules of thumb when attempting to estimate the various risk-adjusted discount rates needed to solve Equation **(6).**[4] Another approach is **suggested below.**

Of the types of risk mentioned above, only replacement cost risk (including salvage value risk) **and** default risk are borne by the lessor. Default risk is compensated in the lending rate, k, and shall not be discussed. Revenue risk is irrelevant to the lessor because it is bonic by the lessee when he makes his investment decision. To show why this is so, assume for the moment that the replacement cost **and salvage** value of the asset are known with **certainty. Still, the** lessee may cancel an operating lease if the present value of the after-tax operating cash *flow* from his use of the **leased** asset falls below the present value of future **lease** obligations. Even so, the lessor will be **indifferent to** the cancellation because, given no uncertainty about the replacement or salvage **value of the** asset, a lease contract wn always be constructed so that the replacement value of the asset is equal to the value of the remaining lease payments. The payoffs to the lessor are:.

Payoff to lessor (given: no replacement cost risk),:;

$$
= \begin{cases} \text{PV (lease payments)} & \text{if NPV (project)} \geq 0 \\ \text{PV (asset)} & \text{if NPV (project)} > 0 \end{cases}
$$

Given no replacement cost uncertainty a **contract can be** written so that

PV (lease payments) = PV **(asset)**

[3]For example, see [10].

---

[4]Maintenance contracts for leased assets are separable from the lease contract itself and can be priced separately. Therefore, we ignore maintenance cost cash flows when we discuss the operating lease contract.

for any point in time. Thus, the lessor is indifferent to revenue uncertainty."
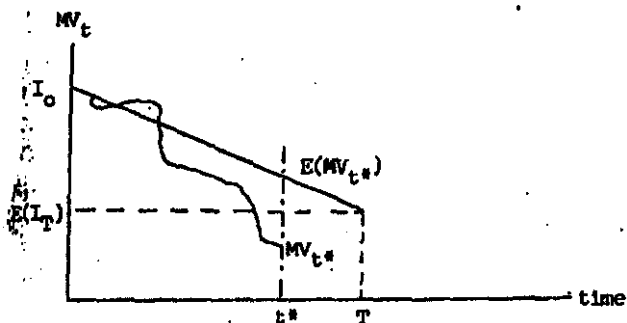
. Given the irrelevance of revenue uncertainty, we can proceed to discuss the effect of uncertain replacement costs (including uncertain salvage value). Exhibit 1 shows how the market value of the leased w e t may change over time. The downward-sloping solid line is the expected decline in the asset's value due to anticipated inflation. wear and tear, and obsolescence. Note that the value of the asset is expected to decline from I_0 to $E(\$I_T)$ over the life of the contract, T years. The expected salvage value is $E(I_T)$. It is reasonable to assume that the value oF the asset never falls below zero. Given replacement cost uncertainty, the actual value of the asset at any time $t^* \le T$ may be greater or less than expected. The particular situation illustrated at t^* in Exhibit 1 shows that if the value of the asset; MV_{t^*}, falls fur enough below its expected value, $E(MV_{t^*})$, then the lessee can improve his position by cancelling the lease, returning the leased asset, und leasing a more efficient replacement to do tlic same job at lower cost. The uptiutr to terminate the lease is an American put held by the lessee. The value of tlic put will be implicit in the lease fees.'

The present value of the relevant American put, P_A, is derived in Appendix A following the assumption of a binomial stochastic process. (Cf. Cox, Ross and Rubinstein [2]). The expected replacement cost of the asset is assumed to decline in u straight line ut tlic rate

---

Exhibit 1. Replacement Cost Uncertainly

$(1-\theta)$ in cach period. Fur convenience, we assume that the lease contract is writtcii so that the present value of tlic remaining lease fees is equal tu the expected replaccment value of the asset in cach time period. Hence the option is written at-(he-money.

If the lease contract is written so that the exercise price of the implicit put declines ut a rute slower than the expected economic depreciution, then the prohability of cancellation increuses. If there arc any sipnificant transactions costs such as installation and removal and resale expenses, then frequent cancellation is undesirable. The opposite situation occurs when the exercise price declines faster than expected economic depreciation. The likelihood of carly exercise decreases and so does the implied value of the cancellation faiture. If there are costs to negotiating the terms of the cancellation fciiture, then the value of the cancellation option must excced negotiation costs. There may well be un optimal relationship hetwccn the rate of decline in the exercise price and the expected economic depreciation of the asset. No matter what it is, Equation (7) will provide u numerical solution for the viiluc of tlic American put implied in the cancellation clause. Modifications in this assumption do not materially alter the form nf tlic option pricing equation. The exercise price. X. fur the American put written on the replacement cost of the asset is the present value of the lease payments represented by the solid line in Exhibit 1. Since the lease payments iiicludc repayment of the expected economic depreciation of the asset. $(1-\theta)$ $E(MV_t)$, we have to price the value of an American put for a case in which the exercise price declines at u non-stochastic rate equal tu the expected decline in the value of the asset (analogous to a non-stochastic dividend payment). The present value of the American put is:

$$P_t = MAX \{X-V, [pP_u + (1-p) P_d] \div r_f\} \qquad (7)$$

where

$$P_u = MAX \{\theta X-d\theta V, [pP_{uu} + (1-p) P_{ud}] \div r_f\};$$
$$P_d = MAX \{\theta X-u\theta V, [pP_{ud} + (1-p) P_{dd}] \div r_f\};$$
$$p = \frac{(u-1) - (r_f-1)/\theta}{u - d}, (1-p) = \frac{(r_f-1)/\theta + (1-d)}{u - d}.$$

Equation (7) may bo solved iteratively in order to provide a numerical solution for any American put option where tlic exercise price on the option declines at a non-stochastic riitc equal tu the ex ante expected decline in the value of tlic asset. If the depreciation rate $(1-\theta)$ is zero, then Equation (7) reduces exactly to the

---

numerical solution of an American put with constant exercise price. derived by **Cox. Ross** and Rubinstein [2]. As the anticipated economic life of **the asset** becomes shorter (*i.e.*, **as** *it depreciates* faster), the value of the put decreases relative *to* its counterpart — an American put with fixed exercise price. Tlic put implied **by** the lease's cancellation clause differs from **a** regular American put because its exerirse price decreases at a predetermined rate. Because the decreasing exercire price is linked *to* tlic anticipated rate of economic depreciation, it follows *that* the put is *worth* **less as** Ihc expected life of tlic underlyiiig asset is shorter.

The effect of the put on the lease fees will be *to* increase them with I) greater uncertainly in the replacement **cost of** the leased asset, **2) decreases** iti the risk-free discount rate, and 3) a lower expected rate of depreciation over **the** life of the lease contract. The first two effects are obvious and **the** third effect makes sense when one realizes that **we arc** talking **about tlic** marginal change in lease fees caused by the cancellation option. The level of **lese** fees will decrease **as** tlic expected rate of economic depreciation decreases, but the cancellation option **has** greater **cost to** the lessor **as** the **life of** the **asset** increases.

An American **put** written **on a** lease contract **and** modeled **as** in Equation **(7)** will *capture the* value of tlic cancellation clause in **an** operating **lease.** The value of the put will depend **on the** following variables:

$$P_A = f(\overset{+}{I}, \overset{+}{\sigma_{MV}^2}, \overset{-}{r_f}, \overset{\mp}{T}, \overset{+}{X}, \overset{+}{\theta}) \tag{8}$$

where I = tlic initial cost of tlic leased asset;

a'_{MV} = tlic instantaneous variance *of* the market value of tlic asset (for annual binomial outconics $u = e^{\sigma}$, where σ is **the annual** standard deviation of asset returns);

r_f = one plus the risk-free **rate for assets of** maturity T;

T = the number of time periods before **the** option expires:

X = the initial exercise price of **tlic** option **(X** = I):

$1-\theta$ = tlic annual rate **of** anticipated straight-line depreciation in the value **of the** asset.

The sign of the partial derivative of the value of the put with respect *to* each of tlic variables *is* given above Equation (8).

The following *numerical* exiimpk shows how the lessor will increase his required lease payments if a lease contract is cancellable. Assume that a **$10,000**

asset is expected **to** have a three-year economic life **and** depreciate an equal amount **each** year (*i.e.*, θ = .667). kowever, its value may be **50** percent higher or lower! than expected at the end ,**of** a given year (*i.e.*, u =. 1.50, d = .667, σ = .405). **The lessor has a tax rate of 40** percent **and** will write a two year lease.[a] If tlic lease, contract were *n* strict financial **lease,** it would require a 10 percent before-tax rate **of return** (*i.e.*, k_a = 10%). The salvage value is uncertain **and** requires a **16% risk-** adjusted rate of **return. For** siaiplicity we ignore capital gains taxation **on the salvage** value and investment **tax** credits. Using our prior definitions of the variables **we** can write the competitive **present** value **of a** non-cancellable lease **to** the lessor **as** follows:

$$0 = -I + \sum_{t=1}^{2} \frac{(1-\tau_r)L_t + \tau_e dep_t}{[1+(1-\tau_e)k_d]^t}$$
$$+ \frac{E(MV)_t}{(1+k_t)^2}. \tag{9}$$

Substituting in **the** appropriate values, and solving **for** the competitive lease fee we have

$$0 = -10,000 + \sum_{t=1}^{2} \frac{(1-.4)L_t + .4(3333)}{[1-(1-.4).10]^t}$$
$$+ \frac{3333}{(1.16)^2}$$

$0 = -10,000 + .6L_t PVIF_a$ *(6%. 2 yrs.)*
$+ .4(3333)PVIF_a$ (6%, 2 yrs.) $+ 3333(.743)$
$0 = -10,000 + .6L_t(1.833) + .4(3333) (1.8339$
$+ 3333(.743)$
$L_t = \$4.619$

Next, we want to determine the competitive lease payments assuming that the above contract is a cancellable operating lease. Equation **(9)** must be modified by subtracting the present value of Ihc American put option. **The** new **valuation** equation is

$$0 = -I + \sum_{t=1}^{2} \frac{(1-\tau_r)L'_t + \tau_e dep_t}{(1+(1-\tau_e)k_d)^t}$$
$$+ \frac{E(MV)_t}{(1+k_t)^2} - P_A. \tag{10}$$

---

[a] For simplicity we will assume that the lessor and the lessee have the same effective tax rate. Differential tax rates do not affect the value of the cancellation clause.

The value of the put (per dollar value of the asset) is given in Exhibit A-4 as .085. Solving for the operating lease fee we have

$$0 = -10,000 + \sum_{t=1}^{2} \frac{(1-.4)L'_t + .4(3333)}{(1+.(1-.4).10)^t}$$

$$+ \frac{3333}{(1.16)^2} - .085(10,000)$$

$$0 = -10,000 + .6L'_t (1.1133) + .4(3333)(1.833)$$

$$+ 3333(.743) - 850$$

$$L'_t = 15,392$$

The lease fee has increased considerably to reflect the extra risk of possible early cancellation of the operating lease.

If b lessee takes the lease fee as an input and tries to compute an internal rate of return (IRR) on the contract without considering the American put, then there will be a considerable upward bias in the IRR. Using the above lease fee the computation would be

$$0 = 1 - \sum_{t=1}^{2} \frac{(1-\tau_c)L'_t + \tau_c dep_t}{(1+IRR)^t} - \frac{E(MV)}{(1+k_t)^2}$$

$$0 = 10,000 + \sum_{t=1}^{2} \frac{(1-.4)(5392) + .4(3333)}{(1+IRR)^t}$$

$$- \frac{3333}{(1.16)^2}$$

$$0 = 10,000 - 4568.4 PVIF_a (IRR\%, 2 \text{ yrs.})$$

$$- 2476$$

$$PVIF_a (IRR\%, 2 \text{ yrs.}) = \frac{-7524}{-4568.4} = 1.647$$

$$IRR \approx 14\% \quad [1]$$

The management of the lessee firm would be mistaken to compare the 14 percent before-tax rate of return with the 10 percent before-tax cost of debt capital. The two rates are not comparable because the cancellable operating lease is riskier than its non-cancellable financial lease counterpart.

Frequently the lease may be cancelled only if a lump-sum penalty, F, is paid to the lessee. The penalty reduces the value of the cancellation clause for the lessee. Numerically, the effect of the penalty can be estimated by subtracting the fee from the exercise price in Equation (7). This is shown below where P_A^* is the present value of the cancellation clause given a cancellation fee, F:

$$P_A^* = MAX\{(X-F)$$

$$- V_t[pP_d + (1-p)P_u] \div r_t\}$$

where

$$P_d = MAX\{(0X-F)$$

$$- d\theta V_t[pP_{du} + (1-p)P_{ud}] \div r_t\};$$

$$P_u = MAX\{(0X-F)$$

$$- u\theta V_t[pP_{ud} + (1-p)P_{uu}] \div r_t\};$$

$$p = \frac{(u-1) - (r_t-1)/\theta}{u - d},$$

$$(1-p) = \frac{(r_t-1)/\theta + (1-d)}{u - d}.$$

Summary

If the lease is a pure financial lease, it is a perfect substitute for debt and we show that the appropriate discount rate for the leasing cash flows (before interest charges) is the after-tax cost of debt capital. On the other hand, it' the lease contract is a cancellable operating lease, it is not a perfect substitute for debt capital and some higher discount rate is appropriate. This rate may be obtained by first computing the present value of an American put with an exercise price that declines at the same rate as the expected decline in the market value of the leased asset. The declining exercise price is necessary so that at any time the expected value of the future lease payments is equal to the expected market value of the depreciating asset. An example shows that the internal rate of return on an operating lease will be greater than on the comparable pure financial lease. However, the apparent higher internal rate reflects the value of the put included in the cancellation clause of an operating lease.

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Analysis of Various Categories of Investment for Virginia

Total Product Investments		Expected	Operating
Forward-Looking Investment	VA-Specific	Life	Expenses
SS7 Investments	$10,069,950		$1,203,359
Operator Services	$15,961,441		$2,604,907
Total Collocation Investments	$103,946,340		$10,810,419
Access to OSS	$2,732,256		$607,381
Support Investments	$576,419,355		$23,622,000
ADSL Incremental	$2,371,923		$246,680
Testing Support Investments	$32,495,505		$1,065,853
DUF Investments	$1,387		$308
Total Switch Investments	$1,345,069,709		$160,735,830
Total Loop Investments	$4,590,372,221		$1,002,996,330
Total IOF Investments	$640,245,882		$66,585,572
Total PubComm Investments	$35,878,432		$2,159,882
AIN Incremental	$457,827		$54,710
Total Forward-looking Investments	$7,356,022,228	14.1	$1,272,693,231

DOCKET NO 00-218; 00-249; 00-251   Attachment A

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